**Citation:**

Skinner JD, Bounds W, Carruth BR, Morris M, Ziegler P. Predictors of children's body mass index: a longitudinal study of diet and growth in children aged 2-8 y. *Int J Obes Relat Metab Disord*. 2004 Apr;28(4):476-82.
**PubMed ID:** 14993908

**Study Design:**

Cohort (longitudinal, prospective)

**Class:**

B - Click here for explanation of classification scheme.

**Research Design and Implementation Rating:**

POSITIVE: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

To describe longitudinal growth and energy intakes from ages 2 to 8 years in 70 children and to identify factors related to the children's body mass index. Additional growth data and food intake variables from the longitudinal data set were included in initial analyses.

**Inclusion Criteria:**

- White children born in 1992, with the majority of births in June, July, and August from Tennessee.
- At risk of overweight: BMI exceeds the 85$^{th}$ percentile
- Overweight: BMI exceeds the 95$^{th}$ percentile

**Exclusion Criteria:**

Infants with birth anomalies and continuing health problems requiring medication.

**Description of Study Protocol:**

**Recruitment**

Participants were in a longitudinal study of children's food patterns and related factors since infancy.

**Design**

Data collected: Height (or length), weight, and child's food and beverage intake (24 hour recall for more frequent, early interviews for ages 2 to 24 months or two food records and a 24 hour recall for less frequent, later interviews for older children).

Also determined child's age at adiposity rebound.

**Statistical Analysis**

General linear model repeated measures analysis of variance (group changes in energy intake over time and gender differences in energy intake), correlation analyses (relationship among independent variables and between variables and children's BMI at 8 years), forward selection stepwise regression analysis (test significance of all variables in selected predictive models).

**Data Collection Summary:**

**Timing of Measurements**

Each child had four to five interviews during the first year of life (at random data points that were months, two to three during the second year, and two during the third year. Beginning at 3.5 year, each child was interviewed at each of the 7 data points (ages 3.5, 4, 4.5, 5, 6, 7, and 8 years).

**Dependent Variables**

BMI

**Independent Variables**

Dietary intake (24 hour recalls and food records) for energy and macronutrient intakes, breastfeeding duration, hours spent watching television, videos and computer games, age at adiposity rebound.

**Description of Actual Data Sample:**

**Initial N**: 70

**Attrition (final N): 70**

**Age**: Infant to 8 years

**Ethnicity**: White

**SES**: Middle and upper class

**Anthropometrics:** 23% (8 males and 8 females) exceeded the 85$^{th}$ percentile for BMI at age 8; 6 of these (9%) exceeded the 95$^{th}$ percentile.

**Location**: Tennessee

**Summary of Results:**

Though male energy intakes were general 420-840 kJ higher than female, differences were not statistically significant.

Average percentage of energy from fat, protein, and carbohydrate were 32, 14, and 56%, respectively.

Dietary fat and dietary protein (both grams and as a percent of energy) variables were positively related to BMI, whereas the percent energy from carbohydrate was negatively related.

Mother's BMI (r=0.26, p=0.03) and television/video/computer time (r=0.29, p=0.01) did not

significantly contribute to the predictive models but were significantly correlated with child's BMI at age 8 years. Children's television/video/computer time was also positively related to the child's BMI at age 2 years (r=0.33, p=0.006) and both parents' BMI (mothers' BMI r=0.24, p=0.04; fathers' BMI r=0.32, p=0.006).

Total energy intake was not included in models; only dietary fat (grams & percent energy), protein (grams & percent energy), and percent energy from carbohydrates were included.

**Author Conclusion:**

The results of this study identify several indicators of developing overweight in young children. These indicators were child's BMI as early as 2 years of age and an early adiposity rebound.

***Reviewer Comments:***

***Strengths:***

- *Reliability of the data: mothers were highly educated (accurate record keeping), mothers participated since the child was an infant and were experienced in providing food intake data.*
- *Face-to-face interviews allowed for probing and checking of data.*
- *Longitudinal design diminishes the effect of a specific day or even a specific 3 day period.*
- *Doubly labeled water studies have shown that parental reports of children's energy intakes, using records/recalls, are reasonably accurate (unlike self-reporting by adolescents or adults).*

***Limitations:***

- *No observations to verify food intake (all self-report).*
- *Total energy expenditure not measured by doubly labeled water methods.*

***Other Comments:***

- *No control variables?*
- *Not generalizable.*

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***Research Design and Implementation Criteria Checklist: Primary Research***

| **Relevance Questions** | | |
|---|---|---|
| 1. | Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies) | N/A |
| 2. | Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about? | Yes |
| 3. | Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice? | Yes |

| | | |
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| 4. | Is the intervention or procedure feasible? (NA for some epidemiological studies) | N/A |

**Validity Questions**

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|---|---|---|
| **1.** | **Was the research question clearly stated?** | Yes |
| 1.1. | Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified? | Yes |
| 1.2. | Was (were) the outcome(s) [dependent variable(s)] clearly indicated? | Yes |
| 1.3. | Were the target population and setting specified? | Yes |
| **2.** | **Was the selection of study subjects/patients free from bias?** | Yes |
| 2.1. | Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study? | Yes |
| 2.2. | Were criteria applied equally to all study groups? | Yes |
| 2.3. | Were health, demographics, and other characteristics of subjects described? | Yes |
| 2.4. | Were the subjects/patients a representative sample of the relevant population? | Yes |
| **3.** | **Were study groups comparable?** | Yes |
| 3.1. | Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT) | N/A |
| 3.2. | Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline? | Yes |
| 3.3. | Were concurrent controls used? (Concurrent preferred over historical controls.) | Yes |
| 3.4. | If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis? | Yes |
| 3.5. | If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.) | Yes |
| 3.6. | If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")? | N/A |
| **4.** | **Was method of handling withdrawals described?** | No |

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| 4.1. | Were follow-up methods described and the same for all groups? | Yes |
| 4.2. | Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.) | No |
| 4.3. | Were all enrolled subjects/patients (in the original sample) accounted for? | Yes |
| 4.4. | Were reasons for withdrawals similar across groups? | N/A |
| 4.5. | If diagnostic test, was decision to perform reference test not dependent on results of test under study? | N/A |
| **5.** | **Was blinding used to prevent introduction of bias?** | ??? |
| 5.1. | In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate? | N/A |
| 5.2. | Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.) | ??? |
| 5.3. | In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded? | ??? |
| 5.4. | In case control study, was case definition explicit and case ascertainment not influenced by exposure status? | N/A |
| 5.5. | In diagnostic study, were test results blinded to patient history and other test results? | N/A |
| **6.** | **Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?** | Yes |
| 6.1. | In RCT or other intervention trial, were protocols described for all regimens studied? | N/A |
| 6.2. | In observational study, were interventions, study settings, and clinicians/provider described? | Yes |
| 6.3. | Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect? | Yes |
| 6.4. | Was the amount of exposure and, if relevant, subject/patient compliance measured? | Yes |
| 6.5. | Were co-interventions (e.g., ancillary treatments, other therapies) described? | N/A |
| 6.6. | Were extra or unplanned treatments described? | N/A |
| 6.7. | Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups? | N/A |
| 6.8. | In diagnostic study, were details of test administration and replication sufficient? | N/A |

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| **7.** | **Were outcomes clearly defined and the measurements valid and reliable?** | Yes |
| 7.1. | Were primary and secondary endpoints described and relevant to the question? | Yes |
| 7.2. | Were nutrition measures appropriate to question and outcomes of concern? | Yes |
| 7.3. | Was the period of follow-up long enough for important outcome(s) to occur? | Yes |
| 7.4. | Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures? | Yes |
| 7.5. | Was the measurement of effect at an appropriate level of precision? | Yes |
| 7.6. | Were other factors accounted for (measured) that could affect outcomes? | Yes |
| 7.7. | Were the measurements conducted consistently across groups? | Yes |
| **8.** | **Was the statistical analysis appropriate for the study design and type of outcome indicators?** | Yes |
| 8.1. | Were statistical analyses adequately described and the results reported appropriately? | Yes |
| 8.2. | Were correct statistical tests used and assumptions of test not violated? | Yes |
| 8.3. | Were statistics reported with levels of significance and/or confidence intervals? | Yes |
| 8.4. | Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)? | N/A |
| 8.5. | Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)? | ??? |
| 8.6. | Was clinical significance as well as statistical significance reported? | Yes |
| 8.7. | If negative findings, was a power calculation reported to address type 2 error? | N/A |
| **9.** | **Are conclusions supported by results with biases and limitations taken into consideration?** | Yes |
| 9.1. | Is there a discussion of findings? | Yes |
| 9.2. | Are biases and study limitations identified and discussed? | Yes |
| **10.** | **Is bias due to study's funding or sponsorship unlikely?** | ??? |
| 10.1. | Were sources of funding and investigators' affiliations described? | Yes |
| 10.2. | Was the study free from apparent conflict of interest? | ??? |